OPTIMIZATION OF ASSEMBLY LINE USING DISCRETE EVENT SIMULATION

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MASTER OF MANUFACTURING ENGINEERING
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DECLARATION

I declare that this project entitled “Optimization of Assembly Line Using Discrete Event Simulation” is the result of my own work except as cited in the references. The project has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree.

Signature :

Name : Nurdiyanah Nasuha Bt Shah Fenner Khan

Date :

APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion, this dissertation/report is sufficient in terms of scope and quality as a partial fulfilment of Master of Manufacturing Engineering (Quality System Engineering).

Signature :

Supervisor Name : Associate Professor. Ts. Dr. Effendi Bin Mohamad

Date :

DEDICATION

The sake of Allah, my Creator and my Master, My great teacher and messenger, Mohammed (May Allah bless and grant him), who taught us the purpose of life,

I dedicate this to my loving parents. Shah Fenner Khan and Salma who have been my source of inspiration and gave me strength when I thought of giving up,

My dearest siblings, who always gives their support and encouragement endlessly,

My friends who encourage and support me, all the people in my life who touch my heart,

I dedicate this research.

ABSTRACT

Nowadays, competition has become more intense for the manufacturing companies than the previous decades. However, many still struggling to increase their quality and the productivity level while keeping the cost at minimum. Thus, in order to stay competitive, manufacturers are expected to develop a sense of commitment towards continuous improvement, and it is important for a company to increase their productivity level. Furthermore, it is vital to increase the productivity level of an assembly line in a manufacturing company as it plays a critical role in obtaining a high quality while keeping the cost at minimum. The productivity level of an assembly line depends on the balancing performance. Moreover, a simulation software was used to foresee the assembly line performance before actual implementation. Therefore, line balancing technique were used to improve the assembly line by assigning the workstations evenly by satisfying the constraint provided. This project aims are to minimize the cycle time of an assembly line using line balancing technique and discrete event simulation. The assembly chosen are the spring adjustment screw assembly, SAS TS83, SAS TS92 and SAS TS93. The data were collected using the time study method. Then, the line balancing technique were used to distribute the task evenly among the workstations. The result which has been gathers from the line balancing technique were then transfer to simulation software in order to enhance the result. The simulation software used in this project is Delmia Quest simulation software. Henceforward, What-if analysis were used to explore and compare various scenarios, based on changing conditions of the assembly line. The use of both line balancing technique and discrete event simulation software shows an improvement in the cycle time and the efficiency of the assembly line from 12.128 seconds to 10.135 seconds, and increase roughly by 14% respectively. Moreover, two different scenarios were proposed, which the first scenario is develop by combining SAS TS92 and SAS TS93 into one workstation, due to they both have the same operating procedures. The second scenarios is by increasing the output produced and thus minimize the cycle time of the assembly for SAS TS92.

ABSTRAK

Pada masa kini, persaingan semakin sengit untuk syarikat-syarikat perkilangan berbanding dekad-dekad terdahulu. Walau bagaimanapun, ramai yang masih bergelut untuk meningkatkan kualiti dan tahap produktiviti sambil mengekalkan kos serendah yang mungkin. Oleh itu, untuk terus berdaya saing, pengeluar sepatutnya mempunyai nilai komitmen untuk menambahbaikkan yang berterusan, dan ia penting bagi sebuah syarikat untuk meningkatkan tahap produktiviti mereka. Tambahan pula, adalah penting untuk meningkatkan tahap produktiviti barisan pemasangan di sebuah syarikat pembuatan,kerana ia memainkan peranan kritikal dalam memperoleh kualiti tinggi sambil mengekalkan kos sekurang-kurangnya. Tahap produktiviti bergantung kepada pengimbangan prestasi. Selain itu, perisian simulasi digunakan untuk meramal prestasi talian pemasangan sebelum pelaksanaan sebenar dijalankan. Oleh itu, teknik mengimbangi digunakan untuk memperbaiki barisan pemasangan dengan mengimbangi stesen kerja secara sama rata dengan memuaskan kekangan yang disediakan. Projek ini bertujuan untuk mengurangkan masa process satu barisan pemasangan menggunakan teknik pengimbangan dan simulasi acara diskret. Pemasangan yang dipilih ialah SAS TS83, SAS TS92, dan SAS TS93.Data dikumpulkan menggunakan kaedah kajian masa. Kemudian, teknik pengimbangan untuk mengimbangi tugas secara sama rata di antara stesen kerja dilakukan. Hasil yang telah dikumpulkan dari teknik pengimbangan kemudian akan dipindahkan ke perisian simulasi untuk memperkukuhkan hasil yang diperolehi daripada teknik pengimbangan. Perisian simulasi yang digunakan dalam projek ini adalah perisian simulasi Delmia Quest. Oleh itu, analisis 'What-If' digunakan untuk meneroka dan membandingkan pelbagai senario, berdasarkan kepada perubahan keadaan. Penggunaan teknik mengimbangi dan perisian simulasi acara diskret dapat mengurangkan masa process dari 12.128 saat ke 10.135 saat dan menunjukkan peningkatan anggaran 14 %. Penggunaan kedua-dua teknik pengimbangan line dan perisian simulasi acara diskret menunjukkan peningkatan dalam masa kitaran dan kecekapan barisan pemasangan. Selain itu, dua senario yang berbeza telah dicadangkan, yang senario pertama dibangunkan dengan menggabungkan SAS TS92 dan SAS TS93 ke dalam satu stesen kerja, kerana kedua-duanya mempunyai prosedur operasi yang sama. Senario kedua ialah dengan meningkatkan output yang dihasilkan dan dengan itu mengurangkan masa kitaran perhimpunan untuk SAS TS92

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GDP	Gross Domestic Product
VA	Value-added
R	Non-value added
ALB	Assembly line balancing
ALBP	Assembly line balancing problem
SALBP	Simple assembly line balancing problem
GALBP	Generalized assembly line balancing problems
COALBP	Cost-oriented assembly line balancing problem
MALBP	Mixed-model assembly line balancing problem
MSP	Mixed-model sequencing problem
UALBP	U-line assembly line balancing problem
RPW	Ranked Positional Weights
C	Cycle time
LBR	Line balancing rate
DES	Discrete event simulation
SAS	Spring Adjustment Screw

CHAPTER 1

INTRODUCTION

1.1 Research Background

In this era of globalization, competition is becoming more intense for the companies than the previous decades. The need to compete globally has driven the manufacturing companies' spirit in becoming more competitive. According to Rishi et al (2016), profits of a company are compelled by costs not profits. The customers expected from us to provide them with better quality, flexible orders, lower price and quick responsive (Rishi et al., 2016). Thus, it is vital for the company to minimize the manufacturing cost without sacrificing the quality of the product. Furthermore, the company required in continually improving their methods of doing business to fulfill the needs of the customer.

According to the report from Department of Statistic Malaysia (2019), Malaysia (Gross Domestic Product) GDP grew by 4.5% in the first quarter of 2019 at a constant price of RM341.7 billion. Moreover, it also reported that all sector shows a positive growth on the production side except for mining and quarrying sector. As shown in Figure 1.1, the manufacturing industry was the second highest sector that contribute towards Malaysia GDP.

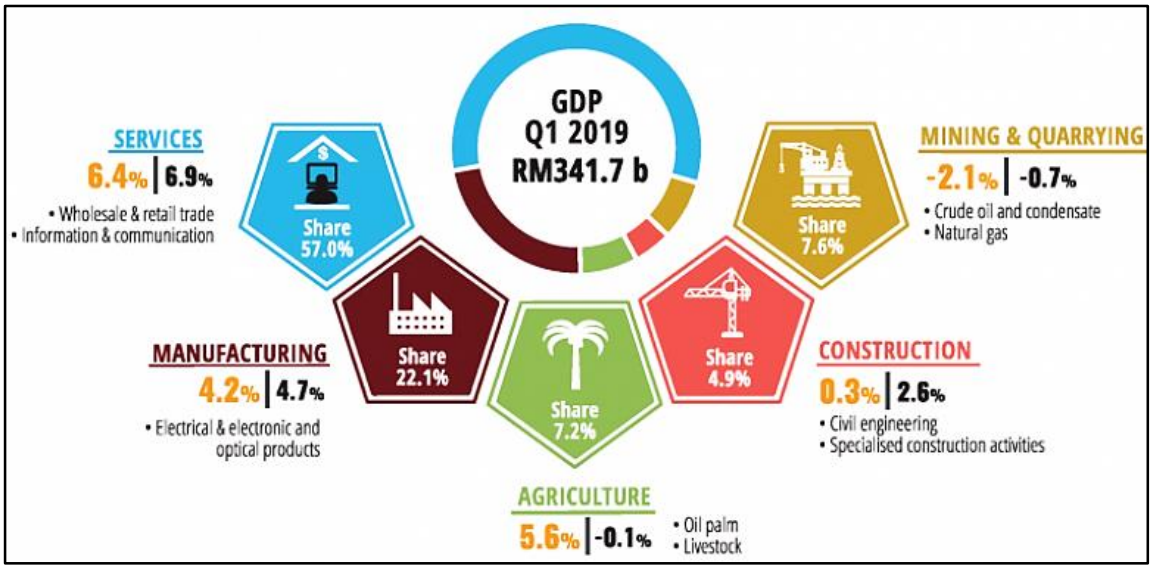

Figure1.1: Malaysia GDP for the first quarter of 2019 (Department of Statistic Malaysia, 2019)

In addition, the growth of the economic of a country is generally determined by its increase in the Gross Domestic Product (GDP) that comes from two different causes, which are the used of more quantity of production factors (input) and a rise in productivity (Duran et al., 2015). Thus, increasing the productivity will drive the economy and as well as companies forward. The productivity of a company can be improved by using Lean Manufacturing. As stated by Nallussamy (2016), lean philosophy benefits the manufacturing sector with reducing the lead time, waste and increase the customer satisfaction.

As stated by Ortiz (2006), in order to stay competitive in a global economy, manufacturer must develop commitment towards continuous improvement and the initial area that needed to be change should be the process of a manufacturing on the production floor. Thus, to improve the productivity of the company, the use of a line balancing will be selected in order to evaluate the productivity of the assembly line. Line balancing can be defined as the problem of assigning tasks to a workstation along the assembly line by satisfying the constraints and optimizing the performance measure (Pachghare and Dalu, 2014; Parvez et al., 2017). Furthermore, the main motivation of a line balancing is to

minimize waste; overproduction, inventory, defects, waiting, transportation, motion and overprocessing (Ikon and Nkechi, 2015). Thus, in order to balance the assembly line, the use of line balancing technique were essential. In addition, it uses the precedence diagram to show the interrelatedness of the workstation.

Moreover, the use of simulation can also help in balancing the assembly line. Besides it is also can be used to predict the performance of the assembly line and consequently find the best performing layout (Yasir & Mohamed, 2018). The simulation that will be used in this project is the Delmia Quest simulation software. This software is a powerful tool which can construct a virtual manufacturing environment which allows the simulation of an existing process takes place (Salleh et al., 2017).

1.2 Problem Statement

Industries nowadays are struggling to increase their productivity level and quality while keeping the production cost at minimum (Bourini et al., 2018). The Star news on May 2019 reported that the CEO of Kossan Rubber Industries Bhd Tan Sri Lim Kuang Sia gives a statement that as a manufacturer the need of continuous improvement is essential, and if the productivity were maintained the same as five years ago, it is impossible to survive (Daniel Khoo, 2019). Thus, it is important for the productivity to improve continuously in order to stay in the competition.

Besides, in remain competitive, productivity and efficiencies of the assembly lines are crucial in a manufacturing company (Yasir and Mohamed, 2018). The assembly line productivity level depends on the balancing performance (Parvez et al., 2017). Thus, the use of a line balancing can help in improving the assembly line. The line balancing purposes is to reduce the number of workstations while maximizing the production rate (Sane et al., 2014).

Based on the observation and semi–structured interview with the supervisor and operator in charge, it appears that the spring adjustment screw assembly line is still new and the cycle time for each of the spring adjustment screw assembly line still needed to be improved as it appears that they are struggling to achieve the daily target demand. Furthermore, the operator of the line stated that they have to work an extra hours to achieve the daily demand. Hence, from there, the need to reduce the cycle time and balance out the workstation is crucial. Therefore, with the use of line balancing technique can help in assigning the task to each workstation, while satisfying the constraints. In order to enhance the result from the line balancing technique, simulation software will be used to give a clear view of the changes made before implementing it. In addition, it offers information regarding the effects of altering and improving lean practice (Omogbai and Salonitis, 2016).

1.3 Objectives

The main objective of this research is to improve the cycle time of the spring adjustment screw assembly line, SAS TS83, SAS TS92, and SAS TS93 at a casting company in Cheng, Melaka. Thus, in order to accomplish the main objective, specific objective were constructed to aid the work flow. The following are the specific objectives of this study:

i. To determine the problems of the spring adjustment screw assembly line.
ii. To analyse the assembly line using the line balancing technique.
iii. To propose an improvement of the assembly line using simulation.

1.4 Scope of the Research

The scopes of this research are:

i. The project concentrates on the assembly line of the spring adjustment screw assembly.

ii. The line balancing technique will be used to balance out the workstation.

iii. Delmia Quest simulation software will be used in enhancing the result obtained.

1.5 Research Question

The research question are as shown below:

i. What is the problem associated with the spring adjustment screw assembly?

ii. What is the optimized solution that can provide an efficient line for spring adjustment screw assembly?

1.6 Project Outline

The project outline describes the main chapter of the project which then will be break down into smaller topics in order to aid in completing this project. All the process will be derived in four different chapters accordingly. This is due to show a clear view of the process flow.

Chapter 1: The study will begin with chapter 1 where a brief explanation on how the project will be conducted. In this chapter, the problem statement based on the company's case study, objectives needed to be accomplished and the scope of the study were presented.

Chapter 2: The second chapter describe the literature review of the study. The literature review comprises of the past researchers study based on their method and tools in overcoming the problem. Besides, it is used to develop more understanding and as a

reference in conducting this study. The reference of this study were collected from books, journal article and several other related sources.

Chapter 3: The third chapter presented the methodology used in this project. This chapter outlines shows how the tools and methods were conducted in completing this project. The procedure and work process were discussed in detail for ease of conducting the project in moving towards achieving the objective of the projects.

Chapter 4: The fourth chapter describe the result of the project as its moving towards achieving the objective of the project.

Chapter 5: The fifth chapter gives the detail summary of all the chapters. Moreover, at the end, an opportunity of an improvement were disclosed as for the continuing of this research.